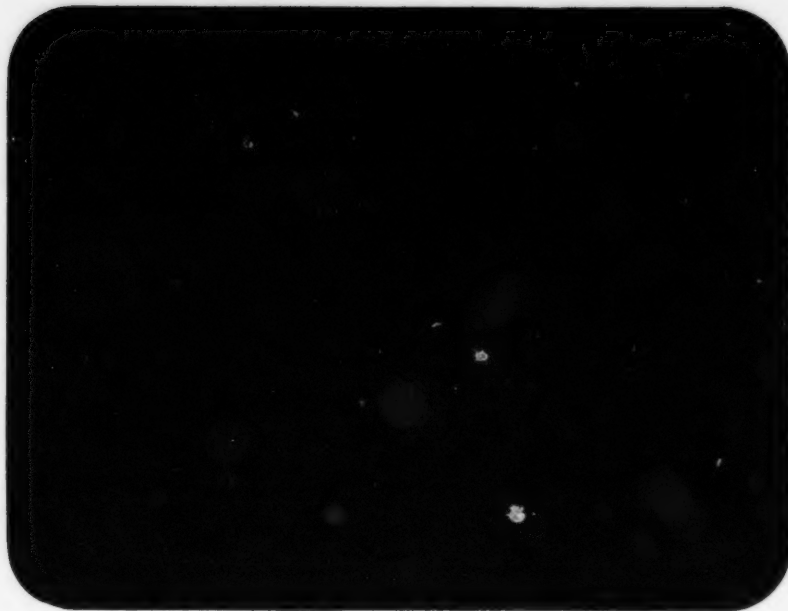




Province of British Columbia
Ministry of Forests

SOUTHEAST BRITISH COLUMBIA
FIBRE RESOURCE STUDY

Ministry of Forests

Date: April, 1989
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ACKNOWLEDGEMENTS

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The authors wish to thank all those contributors for responding to requests for information on short notice. The data and findings presented in this report are based on the best information available at this time. As better data becomes available some of the estimates of recoverable volumes may have to be revised.

SYNOPSIS

The sawmills in the southeast region of the province produce a greater volume of residue chips than required by the existing pulp mill industry. Almost all of this surplus is exported either to the coast or offshore and the rest is disposed of in landfills or burned. This fibre, plus that obtained from harvesting decadent hemlock, cedar and balsam and the stagnant pine along with the recovery of logging waste, tops, smallwood, thinnings, deadwood and understory could provide a fibre supply for additional pulp capacity in the southeast of British Columbia.

The objectives of this study are to:

1. determine the potential supply of by product chips from the sawmills in the study area.
2. determine the "best estimate" of the sawlog and pulp log volumes included and excluded from the Timber Supply Area Yield Analyses.
3. compare the wood supply to existing pulp mill requirements and determine the volume available for future expansion.
4. develop an option for the use of surplus fibre.

Fibre availability is summarized for three supply units which are designated as Kamloops, West Kootenay and East Kootenay. For each Timber Supply Area within these larger zones, the Forest Inventory was assessed. Included in the study are stands which are presently designated problem forest types and excluded from the Allowable Annual Cut (AAC). These comprise decadent and stagnated timber that is useful mainly as pulp furnish but some sawlog potential exists. The pulp log and sawlog components are then separated on the basis of estimated stand composition and end use. The sawlog component is partitioned into lumber and by-product yields. Other potential sources of pulp fibre are also estimated from logging waste, tops, small pine stems, deadwood, understory stems and thinnings. Additional volumes also exist from smallwood (12.5 cm - 17.5 cm dbh, and from incremental fibre from thinnings, however, these last two sources are not quantified for this study.

The results of the wood supply analysis are shown in the following summary table of potential pulp fibre production in each supply unit.

SUMMARY OF FIBRE VOLUMES BY SUPPLY UNIT

Supply Unit	Source	By-Product Fibre			Incremental Fibre	Pulplog Fibre
		Chips	Sawdust	Shavings		
		-----1000's m3/yr-----				
Kamloops	Sawlog Harvest	2785	806	733		
	Pulplogs					700
	Problem Stands	195	57	52		209
	Small Pine				289	
	Logging Waste				167	
	Tops				295	
	Deadwood & Understory Thinnings	55	16	15	628	
	Subtotal	3035	879	800	1379	909
E. Kootenay	Sawlog Harvest	956	277	252		
	Pulplogs					196
	Problem Stands	64	19	17		105
	Small Pine				160	
	Logging Waste				48	
	Tops				104	
	Deadwood & Understory Thinnings	73	21	19	214	
	Subtotal	1093	317	288	526	301
W. Kootenay	Sawlog Harvest	1393	403	366		
	Pulplogs					396
	Problem Stands	70	20	18		338
	Small Pine				27	
	Logging Waste				104	
	Tops				122	
	Deadwood & Understory Thinnings	131	38	34	277	
	Subtotal	1594	461	418	530	734
	TOTAL	5722	1657	1506	2435	1944

The residue column includes by-products from sawlogs in both the operable and problem type stands, assuming continuation of present milling and recovery practices. The incremental column includes fibre which result from a much higher standard of utilization than at present. Roundwood chips result from use of the pulp log component of the stands harvested specifically for pulp. The pulp log fibre supply is based on a 40 year liquidation of problem forest types in order to rehabilitate these sites and recover fibre which is currently being lost.

This fibre provides the supply for existing industry as well as forming the basis for industrial development. The development option promotes the provincial goal of full utilization of the forest resource and demonstrates an opportunity for existing companies to expand or for the construction of new pulp mills or other higher value added facilities.

The estimated fibre supply, both from the present AAC and new sources would support additional capacity in each supply unit as follows:

a) Kamloops Supply Area:

- Kraft pulp, 1 745 mtpd from by-product and whole log chips and 480 mtpd from sawdust and shavings, or
- mechanical pulp, 4 400 mtpd from by-product and whole log chips

b) West Kootenay Supply Area:

- Kraft pulp, 850 mtpd from by product and whole log chips and 420 mtpd from sawdust and shavings, or
- mechanical pulp, 2 140 mtpd from by-product and whole log chips

c) East Kootenay Supply Area:

- Kraft pulp, 400 mtpd from by-product and whole log chips and 290 mtpd from sawdust and shavings, or
- mechanical pulp, 1 020 mtpd from by product and whole log chips

The location of a Kraft mill and/or a mechanical mill in the Kamloops Supply unit will depend on a number of environmental factors outside the scope of this report. On the basis of wood supply the pulp mill could be located in the north where it would depend primarily on the problem forest stands or in the south where it would depend on the surplus residue chips and incremental fibre. The viability of any new mill would depend on rationalizing the by-product fibre supply and on its ability to utilize the higher cost of pulp log and incremental fibre supply volumes.

The major challenge, particularly for a Kraft mill, will be in locating a site which has an adequate water supply and is socially and environmentally acceptable.

Expansion of the Castlegar mill could be supported by harvesting pulp logs from the West Kootenay area. The mill would continue to purchase all by-product fibre from the Boundary and Arrow TSA's. Additional capacity is possible through the use of incremental fibre and sawdust and shavings.

This estimate of fibre supply indicates that an expansion of the pulp mill at Skookumchuck is possible if part of its supply can be obtained from the use of incremental fibre. Additional expansion is also possible through the harvesting of some fibre categories from portions of the West Kootenay Supply area.

All options assume that fibre can be obtained at an average unit cost which can be supported by the market price of pulp and that no new technology is required to harvest and process the problem stands into suitable chips. It would utilize 90% or more of the estimated potential wood supply in each region. As an alternative to the expansions at Skookumchuck and Castlegar, a pulp mill could be located in the Golden - Revelstoke area.

When the problem forest stands are liquidated, pulp fibre would be obtained from a much higher utilization of the forest resource. This could be from:

1. Intensive Forestry.

Intensive forestry programs would provide a large but unknown source of supply. In addition, the rehabilitation of the problem forest stands and other intensive forestry programs will provide an increase in the long run sustained yield. This has not been taken into account in the calculations of the short term supply.

2. Salvage of fire damaged, diseased or bug killed trees.

This source of fibre was not included in the estimated supply but could probably provide a large volume of fibre both in the short and long term. These sources should provide adequate fibre to replace any shortfall after 40 years.

Under the option of full development the present movement of by-product chips to the coast would be restricted to that which would be surplus to the need of industry within the region. If the free flow of chips is to be maintained then the potential for a major new mill in the region is limited.

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SOUTHEAST BRITISH COLUMBIA FIBRE RESOURCE STUDY

Introduction

The sawmills in the southeast region of the province have for some years produced a surplus of wood residues in the form of chips, sawdust and shavings. Almost all of this surplus is exported either to the south coast, south to the U.S. or offshore. That not sold is disposed of in landfills or burned. The volume of residues produced is not sufficient to satisfy the requirements of a large new kraft mill and the companies have been reluctant to base a major expansion using high cost roundwood. Harvesting the decadent balsam, cedar and hemlock stands would have to provide a large part of the additional fibre supply required. Additional incremental supply could come from more intensive utilization in existing stands of logging waste, small stems, deadwood and understory, and tops. The volume of fibre which could be recovered is highly dependent on the price a pulp mill can afford to pay.

The objectives of this study are to:

1. determine the potential supply of by product chips from the sawmills in the study area.
2. determine the "best estimate" of the sawlog and pulp log volumes included and excluded from the Timber Supply Area Yield Analyses.
3. compare the wood supply to existing pulp mill requirements and determine the volume available for future expansion.
4. develop an option for the use of surplus fibre.

The accuracy of the estimates of the volume of recoverable fibre is highly variable. The estimates for by-products chip production and demand were obtained from mill surveys and are considered fairly accurate. On the other hand the estimates for pulp logs from stands excluded from the AAC land base and the estimates for incremental fibre are largely based on "best guesses" by knowledgeable field staff. Any company considering locating a mill within the study area would have to carry out an analysis of the wood supply to confirm that a fibre supply is available at a cost which they can afford.

Background

The Ministry of Forests has carried out several studies to determine the potential for pulp industry expansion in the southern part of the province. The first, "Opportunities for the Expansion of Pulp Production in Southern British Columbia", was completed in March, 1976. This study was an overview of the potential for expansion in the southern half of the province. It concluded that the fibre supply in the southern interior exceeded the pulp mill requirements and that there was substantial opportunity for expansion. In 1980, several companies expressed an interest in developing additional pulping facilities in the southern interior. After the proposals were evaluated it was concluded that there could be conflict between the companies for the same fibre. A study was therefore undertaken to evaluate the potential for expansion in the southeast, i.e., in the Kamloops and Nelson Forest Regions. That report, "Opportunities for Pulp Mill Expansion in Southeastern B.C.", presented in April, 1981 concluded that sufficient surplus sawmill residues could be produced in the region for one 750 mtpd kraft mill if no chips were exported from the region. It also made a rough estimate of the volume of fibre which could be obtained by harvesting the decadent problem forest types in the interior wet belt area. The preliminary estimate indicated that substantial volumes were available, possibly enough to supply a volume equivalent to the requirements for a second 750 mtpd kraft mill.

Because a better understanding of the wood supply was critical to a decision on pulp mill expansion, a study was commissioned to provide a more detailed analysis of all existing and potential sources of pulp fibre. The 1982 study formed the basis for the Ministry to designate the area as Pulpwood Area 8 and call for proposals for development of the surplus fibre. Because of the downturn in the economy in the early 80's no new industries were established using the surplus wood. This present updating of the 1982 study is in response to the improved economic climate, a better potential for new industrial development and a greater awareness of the additional volumes of unused fibre available from the forest.

Description of Study Area

The southeast study area comprises the Nelson and Kamloops Forest Regions (Map 1). Because of the north-south Purcell mountains which restricts the transportation of logs and chips, the Nelson Region is usually divided into two development areas. Each development area is made up of several Timber Supply Areas (TSA's)

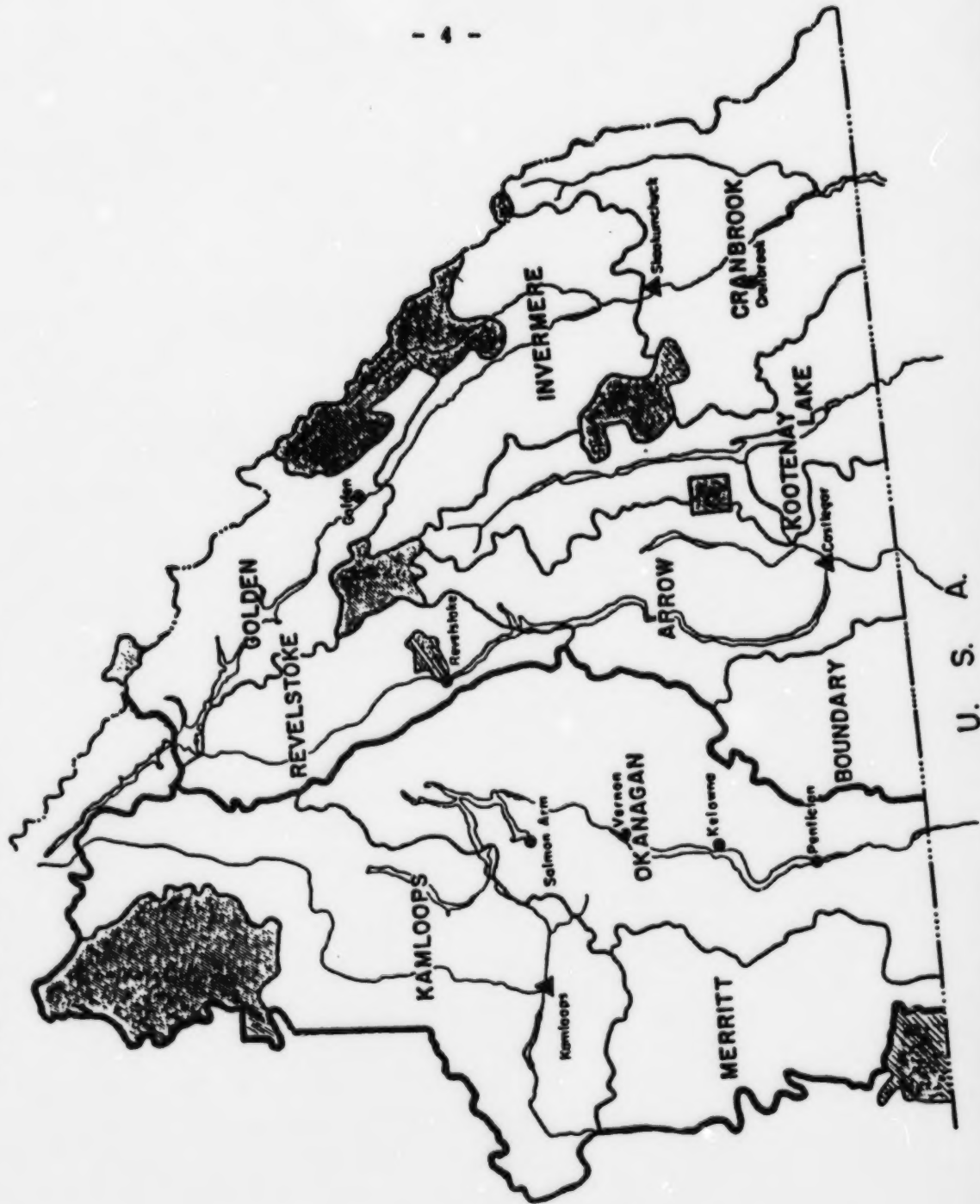
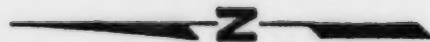
The East Kootenay, the eastern part lying between the heights of land of the Rocky and Purcell Mountains, contains the Golden, Invermere and Cranbrook TSAs. Sawmills are located along the CP Rail from Golden south to the Alberta border. The Crestbrook Forest Industries Ltd. pulp mill is located on this line at Skookumchuck.

The West Kootenay, the western part of the Nelson Region, is defined by the height of land following the Purcell Mountains on the east and the Monashee Mountains and Okanagan Highlands on the west. The Kootenay Lake, Arrow, Boundary, and Revelstoke TSAs are contained in the West Kootenay supply unit. Major sawmills are located at Midway, Grand Forks and Castlegar in the south and at Revelstoke in the north. The Celgar Pulp kraft mill is located in the south at Castlegar.

The Kamloops Region is treated as one development unit except that the Lillooet TSA is excluded from the estimate of fibre because of transportation problems. Chips produced at Lillooet and Lytton are more easily moved either to the coast or north by rail than into the study area.

Sawmills, veneer and plywood plants are dispersed over the Kamloops Region. The Weyerhaeuser kraft pulp mill at Kamloops is the only manufacturing plant using residues.

MAP 1
SOUTHEAST STUDY AREA



Kamloops Region

Log and lumber production has increased in recent years. In 1987 there were 30 operating sawmills with a combined 8-hour shift capacity of 4.58 million board feet of lumber products. The largest operators in the study area were:

Weherhaeuser Canada Ltd.	Princeton Okanagan Falls Lumby Merritt Kamloops Vavenby
Fletcher Challenge Canada Ltd.	Lumby (scheduled to be shut down in 1989) Kelowna Armstrong
Tolko Industries Ltd.	Lavington Merritt Louis Creek Heffley Creek
Slocan Forest Products	Vavenby Clearwater
Adams Lake Lumber	Adams Lake
Federated Co-op Ltd.	Canoe
Riverside Forest Products Ltd.	Lavington
Gorman Bros. Lumber Ltd.	Westbank
Aspen Planers Ltd.	Merritt
Ainsworth Lumber Ltd.	Lillooet
Westar	Malakwa

Six veneer and/or plywood plants operated in 1987: Fletcher Challenge Canada Ltd. in Armstrong and Kelowna, Ainsworth Lumber Ltd. at Savona, Federated Co-operatives Ltd. at Canoe and Tolko Industries at Heffley Creek and Merritt.

By far the largest portion of the log harvest is from Crown lands in the four Timber Supply Areas. Of the 5.6 million hectares of Crown land only about 3.9 million hectares are available for timber production.

Seven Tree Farm Licences with a total area of 0.32 million hectares and a productive area of 0.26 million hectares also provide substantial timber volumes. In addition, private lands and old temporary tenures provide a significant but unregulated supply to the milling industry.

Lodgepole pine, spruce, and Douglas fir are the major species harvested, followed by balsam, hemlock and cedar. Ponderosa pine, larch and western white pine are also important commercial species.

The small lodgepole pine stems which formerly were considered a problem type are now in high demand for furniture components and pine panelling.

Shakes and shingles are produced in the eastern portion of the region, primarily in the Salmon Arm and Clearwater Districts, where there are extensive cedar-hemlock stands. Additional forest employment is provided through the post and pole operation at Kamloops, Monte Lake, Lumby, and Princeton. The post and pole operations depend on the small pine stands for their raw material.

Nelson Forest Region - West Kootenay

In 1987 there were 15 operating sawmills with a combined 8-hour shift capacity of 2.17 million board feet of lumber products. The largest operators were:

Atco Lumber Ltd.	Park Siding
	Fruitvale
Kalesnikoff Lumber Co. Ltd.	Thrums
Slocan Forest Products Ltd.	Slocan
Westar Timber Products Ltd.	Castlegar
Ymir Forest Products Ltd.	Salmo
Pope & Taloot Ltd.	Midway
	Grand Forks
Kozek Sawmills Ltd.	Revelstoke
Downie St. Sawmills Ltd.	Revelstoke
Huscroft Ltd.	Erickson
Wynndel Box & Lumber Co. Ltd.	Wynndel

Two veneer plants are located in the West Kootenays: Atco Lumber Ltd. at Fruitvale, and Crestbrook Forest Industries Ltd. at Creston. A panelboard plant is located at Grand Forks. Celgar Pulp Co. Ltd. operate a 560 tonne per day kraft pulp mill at Castlegar.

Crown lands in the TSA's and TFL's provide the largest volume of timber to industry although of the 3.9 million hectares of Crown land in the TSA's and TFL's only about 1.9 million hectares is available for timber production. The three TFL's also provide substantial volumes to industry. Private lands, and old temporary tenures are a significant but unregulated timber supply.

Spruce, balsam, hemlock, lodgepole pine and Douglas fir are the major species harvested. Western red cedar and larch are also important commercial species in the area.

Nelson Forest Region - East Kootenay Area

There were 6 continuously operating sawmills in the East Kootenay area with a combined 8 hour shift capacity of 1.35 million board feet of lumber. These sawmills were:

Crestbrook Forest Industries Ltd.	Elko
	Canal Flats
	Cranbrook
Galloway Lumber Co. Ltd	Galloway
Evans Products Co. Ltd.	Donald
Radium Forest Products Ltd.	Radium

Crestbrook Forest Industries also operates a 570 tonne per day Kraft pulp mill at Skookumchuck and a veneer mill at Creston. Evans Products Co. Ltd. manufactured veneer and plywood in a plant at Golden.

As in the other units Crown lands in the TSA's and TFL's provide the largest volume of timber to industry, however, substantial volumes are also supplied from private Tree Farm Lands in the Cranbrook TSA.

Regional Fibre Supply

The inventory data base used for this analysis is identical to the data base used for the TSA analyses. Where available Inventory Branch Unit Surveys have been updated to 1988 to account for changes to the forest cover which occurred through fire, logging, or regeneration.

All stands which are included in the Calculation of the Annual Allowable Cut (AAC) are defined as operable. Table 1 summarizes the mature volume by species contained on the land base which contribute to the calculation of the AAC.

TABLE 1 VOLUME IN 1000'S OF m³. MATURE SPECIES, 17.5 CM + CD TO 10 CM TOP FOR OWNERSHIP CODE 62 (CROWN) ONLY

T.S.A.	Fd	p1(3)	CONIFEROUS			OTHER	DECIDUOUS	
			C/H	B	S		A	Bi
Kamloops								
Clearwater Dist(2)	6 140	4 268	10 713 /10 644	15 903	31 961	-	339	186
Kamloops Dist. (2)	29 384	40 379	2 599 / 526	5 793	18 412	-	1 939	647
Okanagan								
Penticton Dist.(3)	8 228	33 089	68 / 0	5 237	12 148	PY/1 185 L/1 331	86	28
Salmon Arm Dist(1)	24 419	5 478	12 353 /11 679	7 869	8 634	L/ 507	249	998
Vernon Dist. (1)	19 482	20 274	7 203 / 5 606	7 526	11 639	L/5 760	601	257
Herritt (2)	18 311	41 924	98 / 147	10 178	22 890		242	5
Lillooet (1)	18 646	12 855	69 / 345	6 735	9 870	PW/PA 64	34	106
Golden (2)	6 053	4 811	5 820 / 3 104	1 164	17 848		891	99
Invermere (1)	12 289	14 870	89 / 8	330	12 167	L/2 511	248	92
Cranbrook (1)	9 527	26 837	632 / 386	3 418	14 133	L/8 646	406	174
Revelstoke Dist.(2)								
TSA (1977)	461	32	5 320 / 7 275	3 561	5 375	19 / 236	1	22
TFL 23 Inc. A10295 (1979)	606	11	9 200 /11 388	2 218	8 642	33 / 398	68	14
TF 38	128	0	1 958 / 1 032	35	51	- / 35	-	-
Timber Licences	17	-	256 / 469	28	238	- / 11	-	-
	1 212	43	16 734 /20 164	6 442	14 306	L W/P 52 680	69	36
Arrow (1)	15 768	7 022	1 694 / 9 931	6 464	7 483	L/5 984	483	207
Kootenay Lake (1)	3 387	5 697	5 585 /11 119	14 320	15 234	L/1 940	126	81
Boundary (1)	6 073	11 853	933 / 487	3 995	5 877	L/6 031	73	22

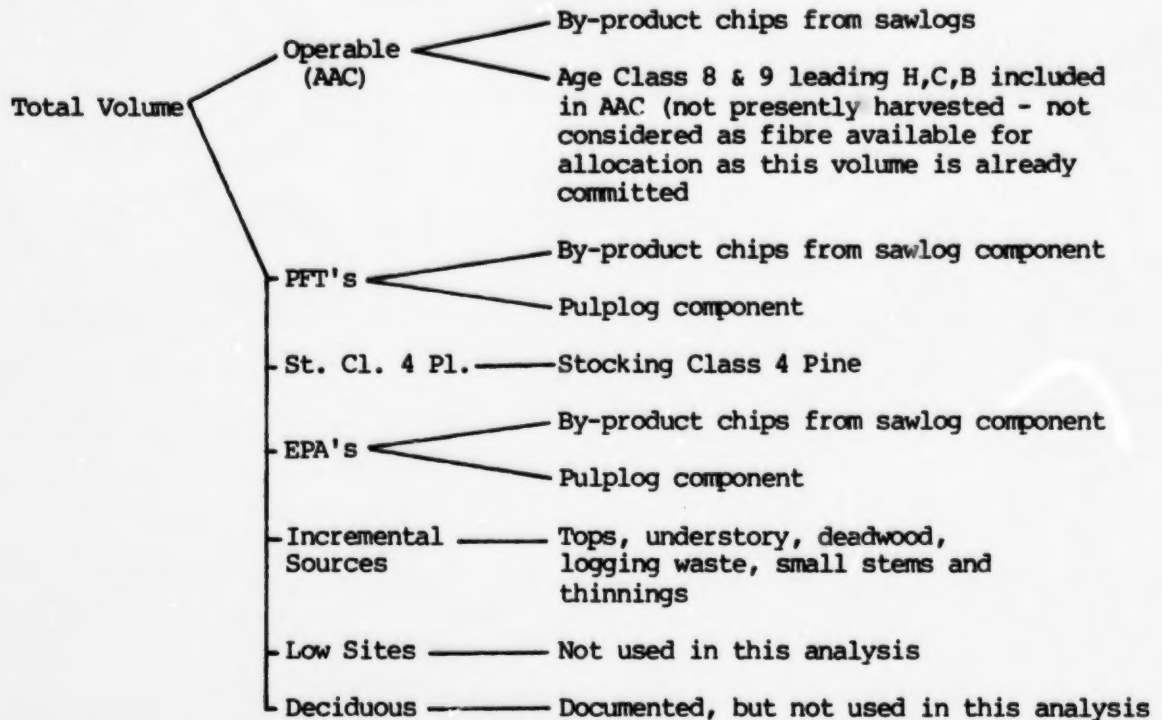
(1) Less waste, decay and breakage ESA's and PFT's.

(2) Less waste, decay and breakage only.

(3) 12.5 cm D.B.H. Less Waste Decay & Breakage Only.

(4) Volumes Provided by Districts = Otherwise Derived from Reductions to Productive Crown Forest.

The diagram below illustrates the sources of the fibre volume used in this analysis:



Timber stands which are not considered economic to harvest for sawlogs because of timber quality are defined as problem forest types and are excluded from the calculation of AAC because of:

- low timber quality or
- inaccessible because of remoteness or extreme topography.

Because these stands are primarily suitable for pulpwood or other non-sawlog use, they are included in this analysis.

Environmental Protection Areas (EPA's) are also removed from the AAC calculation and in addition, for the Nelson Region, an operability line known as the EPF line excluded areas which in the view of regional staff are inaccessible. Percentages of EPA volumes as directed by District staff were included in this study, volumes above the EPF line, however, were not.

Although low site stands may have some potential for fibre production these were considered to be too marginal to be included in this review.

Maps 2, 3, 4 and 5 based on Forest Service Inventory data illustrate the location in the study area of leading hemlock, cedar and balsam types, age class 8 and 9 and stocking class 4 pine as a supplement to the volume data provided in this report.

Area coverage, rather than volume/hectare, was used as the basis for the map compilation because of the high cost required to process the large data bank. It is assumed that area coverage and volume/hectare are linearly related for each species.

The maps were prepared by dividing the total range of coverage per hectare for each species into five approximately equal ranges and by representing each of these ranges in white for the lower range and in a progressively darker shade of green for the more dense coverages.

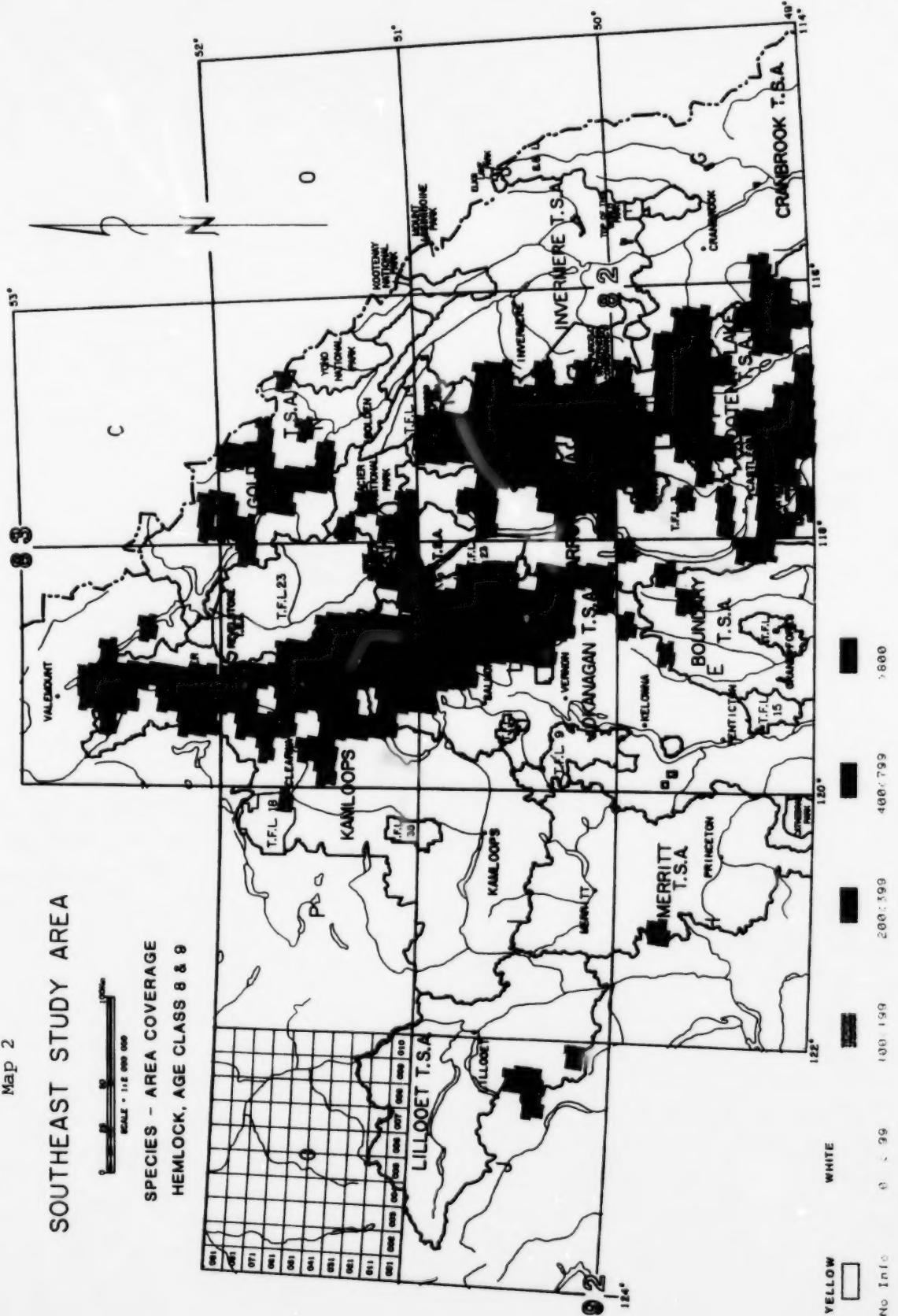
As the maps provide a pictorial presentation only, colour coding was done on the basis of species coverage on a map sheet grid with each map sheet representing 16000 hectares. Criteria for colour coding dictated that if a species range covered more than 50% of the map area, then the colour code for that range would be selected for that map area.

It should be noted that no stocking class 4 pine shows on the area of the Merritt TSA and part of the Boundary TSA because at the time of inventory of these areas, stocking class 4 pine was not an inventory category due to the lack of data on stand densities.

Map 2

SOUTHEAST STUDY AREA

SPECIES - AREA COVERAGE
HEMLOCK, AGE CLASS 8 & 9

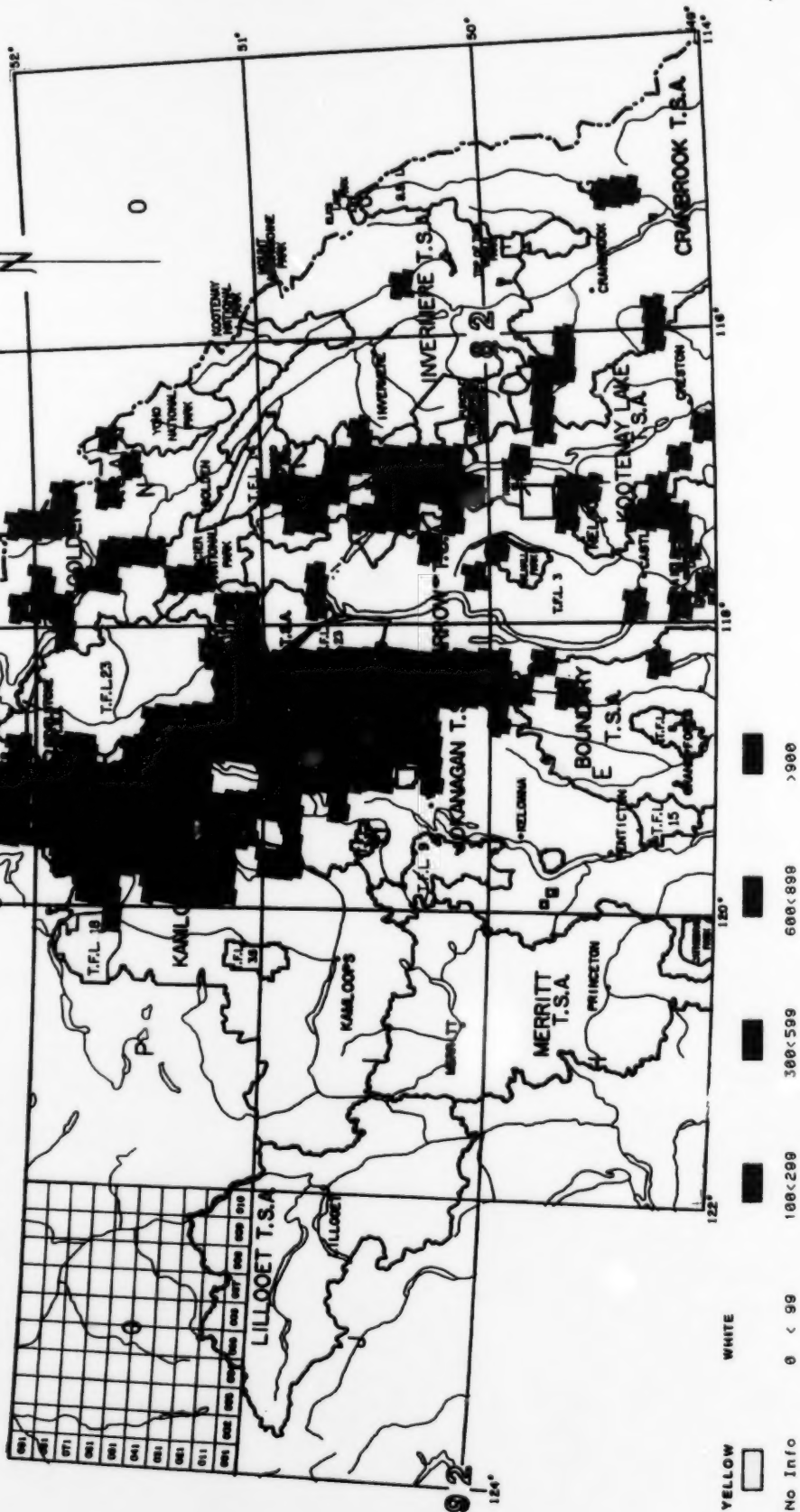


Map 3

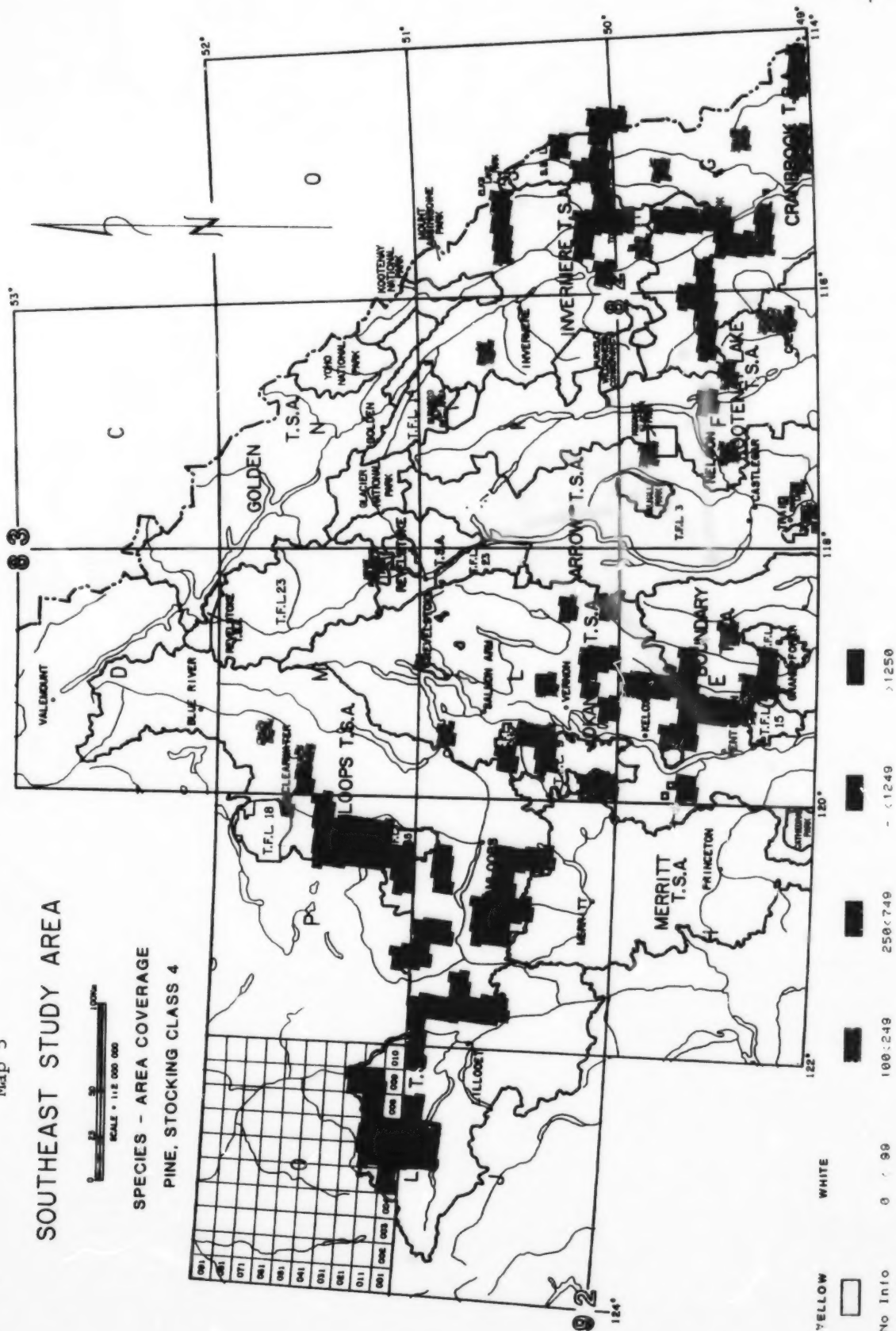
SOUTHEAST STUDY AREA



SPECIES - AREA COVERAGE
CEDAR, AGE CLASS 8 & 9



SOUTHEAST STUDY AREA



Roundwood Fibre Supply

The most critical component of this analysis is the estimate of the volume of pulpwood from the potentially harvestable timber stands.

Three different categories of problem forest types are defined:

- a) decadent cedar-hemlock-balsam species, in stands of age classes 8 and 9 (141 + years);
- b) mature pine type group in stocking class 4 where defined, or;
- c) pine below the standard of utilization as defined by District staff.

The experience of Forest Service district staff was solicited to provide estimates of stand quality and these were reported as follows:

- a) problem forest types leading hemlock, cedar and balsam age class 8 and 9 excluded from the AAC.
- b) leading hemlock, cedar and balsam age class 8 and 9 included in the AAC.

The accuracy of the estimate of the volume of sawlogs and pulpwood depends on the accuracy of the sawlog to pulp log ratios developed by district staff for this study. Because little or no harvesting is carried out in the problem stands the sawlog pulp log sawlog ratios are based on current harvesting practices and on an estimated increase in the level of harvest due to a greater demand for pulpwood. There are a number of cautionary notes which must be made. These are:

1. Some of the pulp log stands may not be economically accessible at the present time but if the price of fibre increases they will become accessible.
2. The levels of sawlog and pulp log harvest are interdependent; that is, a proportion of pulp logs is contained in all stands. If the pulp logs are harvested along with the sawlogs, and there is no market, they will be lost.

3. As a result of the broad age classes for the mature and overmature it is impossible to determine if an age class 9 stand is 250 or 500 years old. Because the VAC volumes level off and do not show a decrease with age, the estimate for decay may be slightly low for the extremely old stands and our estimate of volumes may be slightly high.
4. It is not known what density and height the stagnant pine stands will have when they reach maturity or if they will attain the volumes predicted by the VACs.

Economic constraints have not been considered in the analyses. Obviously, this will have an impact on the amount of available timber.

Currently many stands that are included in the AAC contain a pulp log component. The pulp log component is primarily in the age class 8 and 9 cedar-hemlock-balsam stands. Other species, also included in the AAC, will contribute some volume to the pulp log fibre supply. Presently many of these stands are by-passed by licencees because of their low quality. If there is a market for pulp fibre these stands will become economic to harvest. As these stands are included in the AAC the volume should not be considered as an unallocated fibre source.

Table 2 summarizes the pulp log volumes by District. This table gives an indication of the volume of pulp logs which would be recovered if licencees harvested the species profile in the AAC.

TABLE 2 ESTIMATE OF POTENTIAL ANNUAL FIBRE VOLUME FROM PULP LOGS
INCLUDED IN THE AAC LAND BASE

DISTRICT	-----Volume by Species in 1000's m-----														TOTAL
	Fd	%	Pl	%	C	%	H	%	B	%	S	%	L	%	
CLEARWATER	5.5	5.0	3.8	5.0	19.1	10.0	66.5	35.0	42.6	15.0	57.1	10.0	0.0	5.0	194.6
KAMLOOPS	19.6	5.0	27.0	5.0	3.5	10.0	2.5	35.0	11.6	15.0	24.6	10.0	0.0	5.0	88.8
PENTICTON	5.9	5.0	23.5	5.0	0.1	10.0	0.0	0.0	11.2	10.0	17.3	10.0	0.9	5.0	58.9
SALMON ARM	18.8	5.0	4.2	5.0	19.1	10.0	72.1	40.0	18.2	10.0	13.3	10.0	0.4	5.0	146.2
VERNON	18.6	5.0	19.4	5.0	13.8	10.0	42.8	40.0	21.6	10.0	22.2	10.0	5.5	5.0	143.8
MERRITT	11.4	5.0	26.0	5.0	0.1	10.0	0.7	40.0	19.0	15.0	28.4	10.0	0.0	5.0	85.6
Subtotal	79.8		104.0		55.6		170.2		124.1		163.0		6.8	5.0	703.5
GOLDEN	5.1	5.0	4.1	5.0	9.9	10.0	32.0	60.0	3.0	15.0	30.3	10.0	0.0	5.0	84.4
INVERMERE	12.0	5.0	14.6	5.0	0.2	10.0	0.1	40.0	1.0	15.0	23.8	10.0	2.5	5.0	54.1
CRANBROOK	7.7	5.0	21.7	5.0	1.0	10.0	0.0	0.0	8.3	15.0	22.9	10.0	7.0	5.0	68.6
Subtotal	24.9	5.0	40.4		11.1		20.9		12.2		77.0		9.4	5.0	195.9
REVELSTOKE	0.5	5.0	0.0	5.0	14.1	10.0	67.8	40.0	8.1	15.0	12.0	10.0	0.0	5.0	102.6
ARROW	10.5	5.0	4.7	5.0	2.3	10.0	46.5	35.0	13.0	15.0	10.0	10.0	4.0	5.0	91.0
KOOTENAY LAKE	3.1	5.0	5.3	5.0	10.4	10.0	51.6	25.0	39.9	15.0	28.3	10.0	1.8	5.0	140.4
BOUNDARY	7.3	5.0	14.2	5.0	2.2	10.0	2.3	20.0	14.4	15.0	14.1	10.0	7.2	5.0	61.7
Subtotal	21.5		24.2		28.9		168.3		75.3		64.4		13.0		395.7

TOTAL	126.2		168.5		95.7		359.4		211.7		304.4		29.3	10.0	1,295.2

Source: Factors From 1981 Southeast B. C. Fibre Study And Stewart & Ewing Associates Ltd.

Problem forest types are primarily in age class 8 and 9 hemlock, cedar and balsam and in stagnant pine. As the pine in these stands are primarily below the current utilization standards it is assumed that they will be either used as sawlogs for specialty products such as furniture components or fibre for pulp. Deciduous species have not been included because the available volume was not considered significant as a source of fibre for pulp. The volume in the problem forest types is summarized in Table 3.

TABLE 3 VOLUMES IN PROBLEM FOREST TYPES EXCLUDING LOW SITE AND DECIDUOUS TYPE GROUPS

District	Age class 8 & 9				Stocking class 4 PIII				ESA Volumes				TOTAL EXCLUDED All species (1000's of m3)	
	Leading H, C, B, Excluded From AAC Volumes (1000's of m3)				Excluded from AAC				Not Included in AAC					
	S/L	Pulp	S/L	Pulp	S/L	Pulp	S/L	Pulp	S/L	Pulp	S/L	Pulp		
CLEARWATER	1,082	1,622	1,209	1,813	25	37			1,234	289			3,550	3,761
KAMLOOPS	42	18	113	49	2	1	9,320	490	95	39			9,572	597
PENTICTON					2	1	613		769	85			1,384	86
SALMON ARM	213	850			27	108			750	250			990	1,208
VERNON	173	690	776	86	518	355							1,467	1,121
HERRITT					84	195	2,837	1,216	696	181			3,617	1,592
Subtotal Kamloops	1,510	3,180	2,098	1,948	658	687	12,770	1,706	3,544	844			20,580	8,365
GOLDEN	340	1,358											340	1,358
INVERMERE	3	5	13	43	23	77	800	1,860	838	359			1,677	2,344
CRANBROOK	22	52	36	85	54	360	4,637						4,749	497
Subtotal East Kootenay	365	1,415	49	128	77	437	5,437	1,860	838	359			6,766	4,199
REVELSTONE	73	171	65	153	23	53							161	377
ARROW	12	18	2	3	36	53	66						116	74
KOOTENAY LAKE	891	595	1,774	1,183	2,091	1,394			1,785	1,190			6,541	4,362
BOUNDARY	40	160	77	36			389	909					506	1,105
Subtotal West Kootenay	1,016	944	1,918	1,375	2,150	1,500	455	909	1,785	1,190			7,324	5,918
TOTAL	2,891	5,539	4,065	3,451	2,885	2,624	18,662	4,475	6,167	2,393			34,670	18,482

The estimate of potential recoverable fibre from roundwood is based on applying the pulp log sawlog ratios to the the inventory statistics. The pulp log component of the problem forest types was assumed to be harvested over a 40 year period. Table 4 shows the estimated annual volume of fibre which could be harvested from the problem stands.

TABLE 4 SUMMARY - ESTIMATE OF ANNUAL VOLUME OF FIBRE FROM THE
PROBLEM FOREST TYPES NOT INCLUDED IN THE AAC

District	Pulplogs	Sawmill	
		Chips 3 1 000 m	Sawdust
		- - - - -	- - - - -
Clearwater	94	34	10
Kamloops	15	91	26
Penticton	2	13	4
Salmon Arm	30	9	3
Vernon	28	14	4
Merritt	40	34	10
Subtotal Kamloops	209	195	57
Golden	34	3	1
Invermere	59	16	5
Cranbrook	12	45	13
Subtotal East Kootenay	105	64	19
Revelstoke	92	2	1
Arrow	109	1	0
Kootenay Lake	109	62	18
Boundary	28	5	1
Subtotal West Kootenay	338	70	20
TOTAL	652	329	96

Note: Revelstoke and Arrow estimates include pulp log volumes from TFL 23.

The estimate of volumes include that obtained from both whole log chipping and processing sawlogs. A conservative estimate of by-product recovery of 38 percent was assumed. Because of the low quality of these logs for lumber chip recovery may be higher than assumed. Improvements in milling technology will, on the other hand, tend to decrease the chip yield in the future. Therefore the estimate of 38% yield is considered realistic over the long term.

Harvesting for the roundwood fibre will depend on two factors; one, there must be a demand for the wood and two, the chip price must be high enough to provide an adequate return to operators. Until there is a market for the pulp logs the decadent hemlock and balsam and stagnant pine stands will remain largely uneconomic to log. The estimate of the volume of recoverable fibre depends partly on an "operability line" delineated by the Forest Service. As the price of fibre increases the operability line will move further back or up the slope and in many areas increase the area available for harvest. A substantial amount of fibre will be wasted if operators are forced to fell and burn the low grade logs left after removing all roundwood suitable for lumber production.

Incremental Supplies

In addition to the other sources considered in the analysis, additional fibre can be obtain through better recovery in logging and milling. As fibre demand increases, improved chip recovery from mill trim in sawmills, from the use of finer screens, and from better handling in transport and storage will naturally occur. However, improved milling technology may increase lumber recovery at the expense of chip production.

For the purposes of this study, incremental fibre includes the following categories:

- | | |
|------------------|--|
| Wastewood | - Components of logs, from merchantable trees for all species except pine 17.5 cm d.b.h. and greater to a 10 cm top d.i.b., that are left behind as "unavoidable waste" (i.e. broken pieces) resulting from the various phases of the logging process i.e. W ₂ B). Pine is utilized to a 12.5 cm dbh. |
| Small Pine Stems | - Volumes in small trees, from 12.5 cm to 7.5 cm d.b.h. to a 2.5 cm top d.i.b. |
| Tops | - Volumes in tops of all trees over 12.5 cm d.b.h. from the 10 cm to 2.5 cm top d.i.b. |
| Deadwood | - Dead trees ("snags") of the same merchantable sizes, that are also left behind as waste wood following logging. |
| Understory stems | - Volumes in small trees, from 7.5 cm to 12.5 cm d.b.h. to a 2.5 cm top d.i.b., occurring as an understory in mature forests. |
| Thinnings | - Volume from thinning age class 2 and 3 stands on good and medium sites only. |
| Small wood | - Volumes in small trees in all species except pine 12.5 cm to 17.5 cm dbh. |

Small logs, broken stems and tops could be recovered during logging through better waste recovery, although costs may be high. Because of the lack of reliable data it is difficult to estimate the volume of sound chips which could be obtained from the logging waste by simply applying waste and breakage factors. If harvesting is carried out to obtain the maximum amount of fibre then much of this wood could be extracted at the same time as the sawlogs and pulp logs. As a conservative estimate, 30 to 50 percent of the logging waste in the Kamloops and Nelson regions is assumed to be recoverable. On that basis, the volume of fibre recovered for each region would be as shown in Table 5.

TABLE 5 ESTIMATED ANNUAL VOLUME OF RECOVERABLE FIBRE FROM LOGGING WASTE
FROM ALL STANDS

DISTRICT	-----Volume by Species in 1000's m-----														TOTAL
	Fd	%	PI	%	C	%	H	%	B	%	S	%	L	%	
CLEARWATER	1.4	1.2	1.2	1.5	13.9	5.1	14.2	5.4	7.9	2.7	6.2	1.1	0.0	2.0	44.7
KAMLOOPS	4.7	1.2	11.8	1.5	2.0	5.1	0.2	2.7	2.1	2.7	2.6	1.1	0.0	2.0	23.4
PENTICTON	1.4	1.2	7.5	1.5	0.1	5.1	0.0	2.4	2.1	2.7	1.9	1.1	0.4	2.0	13.3
SALMON ARM	4.6	1.2	1.3	1.5	9.9	5.1	11.4	5.4	3.4	2.7	1.4	1.1	0.2	2.0	32.3
VERNON	4.5	1.2	5.8	1.5	8.1	5.1	6.9	5.4	4.5	2.7	2.3	1.1	2.2	2.0	34.3
MERRITT	2.8	1.2	9.5	1.5	0.1	4.8	0.0	2.4	3.7	2.7	3.0	1.1	0.0	2.0	19.1
Subtotal	19.4		37.0		34.0		32.8		23.7		17.4		2.7		167.0
GOLDEN	1.2	1.2	1.2	1.5	7.4	7.5	5.2	5.4	0.5	2.7	3.2	1.1	0.0	2.0	18.8
INVERMERE	2.0	0.8	5.5	1.5	0.1	4.2	0.0	1.8	0.2	2.7	2.6	1.1	1.0	2.0	11.5
CRANBROOK	1.2	0.8	8.2	1.5	0.6	4.2	0.2	2.1	1.8	2.7	2.4	1.1	2.8	2.0	17.2
Subtotal	4.5		15.0		8.1		5.4		2.6		8.2		3.8		47.5
REVELSTOKE	0.3	3.2	0.0	1.5	8.3	5.7	9.5	5.4	1.5	2.7	1.3	1.1	0.0	2.0	20.9
ARROW	4.2	1.2	2.4	1.5	1.9	5.1	12.1	5.4	4.0	2.7	1.8	1.1	2.7	2.0	29.1
KOOTENAY LAKE	0.8	1.2	1.7	1.5	8.9	4.8	13.9	5.4	10.0	2.7	3.2	1.1	0.8	2.0	39.3
BOUNDARY	1.7	1.2	4.8	1.5	1.0	3.9	0.4	2.7	2.6	2.7	1.5	1.1	2.9	2.0	14.9
Subtotal	7.1		8.8		20.1		35.9		18.1		7.7		6.4		104.2

TOTAL	31.0		60.9		62.3		74.1		44.3		33.3		12.9		318.7

Source: Forest Service waste and breakage factors,
Stewart & Ewing Associates Ltd. estimate of portion recoverable

Table 5 shows the estimated volume and percent of the AAC, by species, of recoverable waste. For example in the Clearwater District fir forms 7.7% of the inventory and of this volume an estimated 1.2% or 1 055 m³ could be recovered. This estimate assumes that the species are harvested in the proportions shown in the inventory.

The increase in volume in utilizing pine down to 7.5 cm dbh is also considered as incremental. At present this wood is not included in the AAC and as it is below the current standard of utilization it is not considered as waste if left on the ground after logging. It forms, however, a large potential source of useable fibre. The better stems in the 10 cm dbh range are in high demand for furniture stock particularly in the Penticton area and in the western part of the Boundary TSA. There is also a thriving post and pole industry using pine stems on the 7.5 cm to 15 cm dbh range in both the Nelson and Kamloops Regions.

Table 6 shows the estimated volume, based on harvesting the small pine stands over a 40 year period.

TABLE 6 ESTIMATED ANNUAL VOLUME FROM SMALL PINE STEMS

<u>Volume</u>	<u>District</u>
	1 000 m ³
Clearwater	-
Kamloops	196
Penticton	12
Salmon Arm	-
Vernon	-
Merritt	81
	<u>289</u>
Golden	-
Invermere	67
Cranbrook	93
	<u>160</u>
Revelstoke	-
Arrow	-
Kootenay Lake	-
Boundary	26
	<u>27</u>
TOTAL	476

Harvesting all stems down to a one inch top d.i.b. could provide a large volume of fibre. Table 7 shows the estimate of fibre volume which could be obtained if the tops were recovered at the time of harvesting. This table is based on data provided by Stewart & Ewing Associates Ltd. consulting foresters.

TABLE 7 ESTIMATED ANNUAL VOLUME OF RECOVERABLE FIBRE FROM TOPS

DISTRICT	-----Volume by Species in 1000's m ³ /y-----														
	Fd	%	Pl	%	C	%	H	%	B	%	S	%	L	%	TOTAL
CLEARWATER	2.7	6.3	4.9	11.5	7.6	17.7	3.2	7.3	12.9	30.0	11.7	27.2	0.0	0.0	43.0
KAMLOOPS	9.5	13.8	49.5	72.3	1.1	1.6	0.1	0.1	3.4	5.0	4.9	7.2	0.0	0.0	68.5
PENTICTON	2.9	6.9	31.4	75.3	0.0	0.1	0.0	0.0	3.4	8.1	3.5	8.5	0.5	1.2	41.6
SALMON ARM	9.3	29.6	5.4	17.4	5.5	17.5	2.5	8.1	5.6	18.0	2.7	8.7	0.2	0.6	31.2
VERNON	8.9	16.6	24.4	45.3	4.5	8.3	1.5	2.9	7.3	13.5	4.4	8.3	2.8	5.1	53.8
MERRITT	5.6	9.7	39.8	69.6	0.0	0.1	0.0	0.0	6.0	10.4	5.8	10.1	0.0	0.0	57.2
Subtotal	38.8		155.5		18.7		7.4		38.5		33.2		3.4		295.4
GOLDEN	2.5	13.4	5.2	27.9	2.8	15.0	1.1	6.2	0.9	4.7	6.1	32.8	0.0	0.0	18.5
INVERMERE	6.0	16.7	23.2	64.6	0.1	0.3	0.0	0.0	0.4	1.1	4.9	13.8	1.3	3.5	35.9
CRANBROOK	3.7	7.4	34.6	69.6	0.4	0.7	0.1	0.2	2.9	5.8	4.6	9.2	3.5	7.0	49.8
Subtotal	12.2		63.0		3.2		1.3		4.2		15.6		4.8		104.1
REVELSTOKE	0.2	2.2	0.0	0.2	4.1	36.1	2.1	18.6	2.5	21.7	2.4	21.2	0.0	0.1	11.4
ARROW	8.5	23.9	10.0	28.3	1.1	3.0	2.7	7.6	6.5	18.3	3.4	9.5	3.4	9.5	35.5
KOOTENAY LAKE	1.6	4.0	7.1	17.7	5.2	12.8	3.1	7.7	16.4	40.5	6.1	15.0	1.0	2.4	40.4
BOUNDARY	3.5	10.0	20.0	57.1	0.7	2.0	0.2	0.6	4.2	12.0	2.8	8.0	3.6	10.3	35.0
Subtotal	13.8		37.2		11.0		8.1		29.5		14.6		7.9		122.2
TOTAL	64.8		255.6		33.0		16.7		72.2		63.4		16.1		521.8

Source: Recovery Factors developed by Stewart & Ewing Associates Ltd.

In the Clearwater District fir forms 7.7% of the inventory and of this volume an estimated 2 700 m³ could be recovered. This estimate assumes that the species are harvest in the proportions shown in the inventory.

Additional sources of fibre could be obtained from deadwood (snags) and the recovery of understory in stands other than pine. Stewart & Ewing Associates Ltd. in cooperation with Crestbrook Forest Industries Ltd. have carried out studies of the volume of fibre if deadwood and understory stems were recovered from current logged areas. Factors developed from their study were applied to the AAC to arrive at an estimate of the volume which could be obtained from the south east study area. Table 8 shows the estimated volume of recoverable deadwood and understory by species for each district.

TABLE 8 ESTIMATED ANNUAL VOLUME OF RECOVERABLE FIBRE FROM DEADWOOD
AND UNDERSTORY

DISTRICT	-----Volume by species in 1000's m3-----														Total
	Fd	%	Pl	%	C	%	H	%	B	%	S	%	L	%	
CLEARWATER	3.6	3.2	10.0	12.8	33.2	12.2	6.5	2.5	30.2	10.3	23.4	4.0	0.0	6.4	106.9
KAMLOOPS	12.6	"	100.3	"	4.7	"	0.2	"	8.0	"	9.9	"	0.0	"	135.7
PENTICTON	3.8	"	63.5	"	0.1	"	0.0	"	7.9	"	7.1	"	1.2	"	83.6
SALMON ARM	12.3	"	11.0	"	23.8	"	5.3	"	13.1	"	5.5	"	0.5	"	71.5
VERNON	11.9	"	49.4	"	19.4	"	3.2	"	17.0	"	8.9	"	7.0	"	116.9
MERRITT	7.4	"	80.6	"	0.2	"	0.0	"	14.0	"	11.6	"	0.0	"	113.7
Subtotal	51.7		314.7		81.4		15.3		90.2		66.3		8.8		628.4
GOLDEN	3.3	"	10.4	"	12.1	"	2.4	"	2.0	"	12.1	"	0.0	"	42.3
INVERMERE	8.0	"	47.0	"	0.4	"	0.0	"	0.9	"	9.9	"	3.3	"	69.4
CRANBROOK	4.9	"	70.1	"	1.6	"	0.2	"	6.8	"	9.1	"	8.9	"	101.7
Subtotal	16.2		127.5		14.1		2.6		9.7		31.2		12.2		213.5
REVELSTOKE	0.3	"	0.0	"	17.8	"	4.4	"	5.8	"	4.8	"	0.0	"	33.2
ARROW	11.3	"	20.3	"	4.7	"	5.6	"	15.2	"	6.7	"	8.6	"	72.3
KOOTENAY LAKE	2.2	"	14.4	"	22.6	"	6.4	"	38.3	"	12.1	"	2.5	"	98.4
BOUNDARY	4.7	"	40.4	"	3.1	"	0.4	"	9.9	"	5.6	"	9.2	"	73.3
Subtotal	18.5		75.2		48.1		16.8		69.1		29.3		20.3		277.2
TOTAL	86.4		517.4		143.6		34.6		169.0		126.7		41.3		1,119.1

Source: Recovery Factors developed by Stewart & Ewing Associates Ltd.

Note: Factors applied to species distribution in inventory

Thinnings

A potentially large future source of pulp fibre could come from thinning immature stands. The estimated volume in this study is based on thinning age class 2 and 3 stands on good and medium sites only. In each unit this area was reduced by approximately 50 percent to arrive at an approximation of the area which would be thinned. Some of the stems would be of merchantable size and would be processed into lumber, chips, sawdust and shavings and the rest small stems and tops which would be whole log chipped. In addition there would be a potential volume from the recovery of tops and understory from the thinned stands. This study did not attempt to estimate a volume from this source. The potential volumes shown in Table 9 are considered conservative. However, the actual recoverable pulp fibre volume would depend on the volume of sawlogs in the stands.

TABLE 9 ESTIMATED POTENTIAL FIBRE VOLUME FROM THINNING
GOOD AND MEDIUM SITES

TSA	Harvest	Chips	Sawdust	Shavings
	-----000 m3/yr-----			
Kamloops	60	23	7	6
Okanagan	65	25	7	7
Merritt	20	8	2	2
subtotal	145	55	16	15
Golden	6	2	1	1
Invermere	85	32	9	9
Cranbrook	102	39	11	10
Subtotal	193	73	21	19
Revelstoke	57	22	6	6
Arrow	115	44	13	12
Kootenay Lake	65	25	7	7
Boundary	107	41	12	11
Subtotal	344	131	38	34
TOTAL	682	259.	75	68

Note: Revelstoke and Arrow TSA's contain estimates for thinnings from
TFL 23.

Small wood

Small wood is defined as stems from all species except pine from 12.5 cm to 17.5 cm dbh. At present utilization standards this wood is not required to be harvested. Although not quantified in this report small wood could provide a substantial volume of fibre. As much of this fibre could be recovered at the time of logging for sawlogs and would provide a source of high quality pulp fibre at a lower cost than other incremental sources. In some areas some of this small wood is presently being recovered and used in the sawmills.

By-Product Fibre Supply

The potential sawlog harvest from Crown land is based on the current TSA analysis. The sawlog harvest from TFL 23 is based on information supplied by Westar. For other TFLs and TIFs the sawlog portion of the present AAC is assumed to be similar to that of adjacent units. An estimate of the annual sawlog harvest from special timber licences is also included. Current utilization standards are assumed for both logging and milling operations. The by-product chip fibre supply was calculated as 38 percent of the sawlog production and compared to the reported chip fibre production for 1987. Table 10 summarizes the potential sawlog by-product chip, sawdust and shaving production from each TSA.

TABLE 10 BY-PRODUCT CHIP PRODUCTION FROM LUMBER AND VENEER MANUFACTURE

UNIT	POTENTIAL				1987 LOG CONSUMPTION	REPORTED CHIP PRODUCTION
	SAWLOG HARVEST	CHIPS (38%)	SAWDUST (11%)	SHAVINGS (10%)		
			-000m3/yr-			
Kamloops TSA	2,350.1	893	259	235		
TFL 18	210.0	80	23	21		
TFL 35	88.0	33	10	9		
Temp. Tenures (est.)	72.0	27	8	7		
(Subtotal Kamloops)	2,720.1	1,034	299	272	3,103.0	1,060
Okanagan TSA	2,900.0	1,102	319	290		
TFL 15	72.0	27	8	7		
TFL 33	29.0	11	3	3		
TFL 49	380.0	144	42	38		
Temp. Tenures (est.)	66.0	25	7	7		
(Subtotal Okanagan)	3,447.0	1,310	379	345	3,999.4	1,332
Merritt TSA	1,161.8	441	128	116	1,778.8	821
Total Kamloops Region	7,328.9	2,785	806	733	8,881.2	3,213
Revelstoke TSA (EST.)	214.6	82	24	21	24.0	0
TFL 23	236.8	90	26	24		
Temp. Tenures (est.)	50.0	19	6	5		
(Subtotal Revelstoke)	501.4	191	55	50		0
Arrow TSA	619.0	235	68	62		
TFL 3	108.0	41	12	11		
TFL 23	492.6	187	54	49		
Temp. Tenures	35.0	13	4	4		
(Subtotal Arrow)	1,219.6	477	138	125	1,556.2	587
Boundary TSA	700.0	266	77	70		
TFL 8	145.0	55	16	15		
(Subtotal Boundary)	845.0	321	93	85	869.0	325
Kootenay Lake TSA	900.0	342	99	90		
TTFs	103.7	39	11	10		
Timber Agreement Land	60.0	23	7	6		
(Subtotal Kootenay Lake)	1,063.7	404	117	106	261.0	88
Total West Kootenay Area	3,629.7	1,393	403	366	2,686.2	1,000
Golden TSA	650.0	247	72	65		
Temp. Tenures (est.)	10.0	4	1	1		
(Subtotal Golden)	660.0	251	73	66	492.3	339
Invermere TSA	696.2	265	77	70		
TFL 14	122.5	47	13	12		
TTF 72	7.8	3	1	1		
Temp. Tenures	2.0	1	0	0		
(Subtotal Invermere)	828.5	315	91	83	1,259.1	462
Cranbrook TSA	873.8	332	96	87		
TFL 13	27.2	10	3	3		
TTF 27	127.0	48	14	13		
(Subtotal Cranbrook)	1,028.0	391	113	103	1,392.8	557
Total East Kootenay Area	2,516.5	956	277	252	3,144.2	1,359
Total Nelson Region	6,146.2	2,349	680	618	5,830.4	2,359
Total Study Area	13,475.1	5,134	1,486	1,351	14,711.6	5,571

Georgia Pacific Building Material Sales Ltd. has recently constructed a chipping plant at Cache Creek. This plant is expected to produce about 250 000 m³ of chips annually from low grade logs, mainly from within the study area. This production is not included in the estimate of by-product supply as all production will be shipped to the parent company's plant at Bellingham, Washington, U.S.A.

Present Demand for By-product Fibre

At present, there is little competition among the three pulp mills in the southeast for fibre supplies as there is sufficient sawmill capacity to produce a larger volume of high quality by-product chips than required by the pulp mills. Currently, only the Celgar pulp mill at Castlegar has a wood room with round-log chipping capability. In 1987 Celgar produced 216,663 m³ of chips at its wood room from pulp logs. The wood room was shut down in 1988 as the company found that it could obtain sufficient by-product chips from the East Kootenay supply unit. The other two pulp mills depend on chips produced in sawmills for their fibre supply. Table 11 shows the present capacity and fibre requirements for the three pulp mills.

TABLE 11 PULPMILL CAPACITY AND ANNUAL FIBRE REQUIREMENTS

<u>Company</u>	<u>Pulp Capacity</u> tonnes/day	<u>Annual Fibre Requirements at Capacity</u>	
		chips	sawdust
		- - 1 000 of m ³ - -	
Crestbrook	540	1 100	
Celgar	560	1 130	
Weyerhaeuser	1 200	1 780	673

Assumed operating at 350 days per year.

Comparison of By-product Supply and Demand

The estimate of sawlog harvest from Crown lands in this analysis is close to present commitment. The sawlog consumption of the sawmills includes timber from Crown lands, private tenure and Crown granted lands and is consequently greater than the commitment.

The by-product chip production in each region is greater than the present demand of the pulp mills (Table 12). In 1987 about 1.6 million m³ of chips from this surplus was shipped to the coast and exported to the U.S. or Japan. The rest was either stockpiled, land filled or burned.

TABLE 12 ESTIMATE OF ANNUAL BY-PRODUCT CHIP SURPLUS

Supply Unit	Chip Supply		Chip	Surplus at Capacity	
	From	From	Requirements	From	From
	Potential	1987	at Pulp Mill	Potential	1987
	Harvest	Harvest	Capacity	Harvest	Harvest
	-----		1 000 m ³ /yr	-----	
Kamloops	2 785	3 213	1 780	1 005	1 433
West Kootenay	1 393	1 000	1 130	263	-130
East Kootenay	<u>956</u>	<u>1 358</u>	<u>1 100</u>	<u>-144</u>	<u>258</u>
Total	5 134	5 571	4 010	1 124	1 561

NOTE: The woodroom at the Celgar Pulpmill produced 216 663 m³ of chips in 1987 from purchased pulp logs. This volume is not included in the 1987 supply.

The division of the Nelson Region into two supply units in this table does not reflect the current movement of chips in the Region as these are substantial volumes of chips moving in both directions between supply units.

Factors Which Influence Pulp Mill Expansion

This section discusses some of the factors which influence the location of a pulp mill. Because of the large volumes of material required in the pulp process the capability to efficiently transport fibre to the mill site is essential, other factors such as environmental pollution, both air and water, and water and energy supplies are important in choosing a site.

Transport of Fibre

Geographic barriers constrain transportation routes and restrict the movement of fibre in the study area to some extent. There is at present no movement of fibre between the Kamloops Region and the Nelson Region.

The Crestbrook pulp mill at Skookumchuck obtains most of its fibre from the East Kootenay supply area. Some fibre is obtained from Crestbrook's own sawmills in the West Kootenay area and transported by rail to Skookumchuck.

The Celgar pulpmill at Castlegar draws most of its fibre from a region bounded by the Purcell Mountains to the east, the Monashee Range to the west, and the U.S. Border to the south. Northern expansion for this region is limited by economic distance. The present transport of wood fibre is by road and rail which extend east, west and somewhat north, as well as by water transport on the Arrow and Kootenay Lakes. At present, Westar transports logs via the Arrow lake system from Revelstoke south to Castlegar. The transport of chips on the lakes has been examined but because of the difficulties of by-passing the dams the cost was considered too high. Some fibre is presently transported by rail from the northern part of the East Kootenay area to Castlegar.

The greatest volume of surplus by-product chips lies in the Kamloops Region. The pulp mill at Kamloops presently obtains sufficient fibre from northern parts of the Kamloops Region. Road and rail links provide access to sources of fibre south and west to Merritt and Princeton, south and central to

Okanagan Falls, east to Revelstoke and north to Valemount. A gap in the rail networks between Kelowna and Penticton means that chips from the south Okanagan must be transported by truck or follow a circuitous rail route via Spences Bridge to reach the pulp mill at Kamloops. This means that as long as the pulp mill at Kamloops has sufficient accessible lower cost fibre, residues from the south Okanagan will continue to be shipped elsewhere from the region or wasted.

Pulping Processes

Until recently pulp manufactured in the interior was produced in large mills by the kraft process. New chemi-mechanical pulp mills are being established either in conjunction with existing pulp mills, as at MacKenzie or as independent plants at Quesnel and Taylor.

Thermo-mechanical (TMP) and Chemi-Mechanical (CMP) mills are of interest because of their high yields and small minimum size compared to kraft mills. This makes them adaptable to locations with relatively limited fibre supplies.

The main advantages of kraft over mechanical or other chemical processes are:

- a) it produces a very desirable, stable product with a high market demand,
- b) it is able to use almost any wood species to produce a high strength pulp,
- c) it has the ability to recover and reuse process chemicals, and
- d) there is a concurrent recovery of by-product heat.

There are constraints to the use of the kraft process, however, which will influence decisions on new mills. These include:

- a) high capital cost per unit of production because of the complex recovery boiler system, pollution control requirements and a very large minimum efficient size, in the order of 750 metric tonnes per day. Present day capital costs per mill are in the order of 450 million dollars.

- b) lower yield than other processes which combined with the high minimum size requires a wood supply of about 500 000 BDUs of chips per year.
- c) costly control of air and water pollution.

Effluents from a large mill can create environmental problems which are expensive and technically difficult to correct. Air-borne emissions from chemical pulping, detectable at low concentrations pose problems in siting a mill near interior communities. This is a problem, especially in interior valley locations where entrapment of air prevents dispersal and dilution.

The greatest disadvantage to the production of market Chemi-mechanical pulp is that only a limited range of wood species can be used. Presently spruce and aspen are the preferred species with pine slightly less acceptable.

Development Opportunities

The analysis of wood supply has shown that the entire Southeast study area's present commitment could provide sufficient by-product chips for the three existing pulp mills plus about 550 mtpd of Kraft pulp or 1 400 mtpd of mechanical pulp. Residue sawdust and shavings could yield another 1 000 mtpd of Kraft. Any additional pulp capacity beyond this level would have to depend on fibre obtained from harvesting problem forest types, mainly the decadent hemlock, cedar and balsam and the stagnant pine stands and on the recovery of logging waste, small stems, tops and other incremental fibre.

Table 13 gives a summary of the estimated recoverable volumes for each Supply Unit. This estimate of fibre supply provides the supply for existing industry as well as forming the basis for new pulp capacity in the southeast. Any option must take into consideration the viability of existing companies as well as ensuring the best return to the province. A large expansion of pulping capacity in one location would limit the number of future options in the region. For example if a Kraft mill were to be located in the Revelstoke - Golden area then the potential expansions at Castlegar and Skookumchuck would be limited.

TABLE 13: SUMMARY OF FIBRE VOLUMES BY SUPPLY UNIT

Supply Unit	Source	By-Product Fibre			Incremental Fibre	Pulplog Fibre
		Chips	Sawdust	Shavings		
		-----1000's m3/yr-----				
Kamloops	Sawlog Harvest	2785	806	733		
	Pulplogs					700
	Problem Stands	195	57	52		209
	Small Pine				289	
	Logging Waste				167	
	Tops				295	
	Deadwood & Understory				628	
	Thinnings	55	16	15		
Subtotal		3035	879	800	1379	909
E. Kootenay	Sawlog Harvest	956	277	252		
	Pulplogs					196
	Problem Stands	64	19	17		105
	Small Pine				160	
	Logging Waste				48	
	Tops				104	
	Deadwood & Understory				214	
	Thinnings	73	21	19		
Subtotal		1093	317	288	526	301
W. Kootenay	Sawlog Harvest	1393	403	366		
	Pulplogs					396
	Problem Stands	70	20	18		338
	Small Pine				27	
	Logging Waste				104	
	Tops				122	
	Deadwood & Understory				277	
	Thinnings	131	38	34		
Subtotal		1594	461	418	530	734
TOTAL		5722	1657	1506	2435	1944

In order to calculate the fibre requirements for new or expanded pulp mills it was assumed that all pulp mills would operate at capacity for 350 days per year and use 5.8 m^3 per tonne of Kraft pulp, or 2.3 m^3 per tonne of mechanical pulp. The estimated fibre supply, both from the present AAC and potential new sources could support additional capacity in each supply unit as follows:

a) Kamloops Supply Area:

- Kraft pulp, 1 745 mtpd from by-product and whole log chips and 480 mtpd from sawdust and shavings, or
- mechanical pulp, 4 400 mtpd from by-product and whole log chips

b) West Kootenay Supply Area:

- Kraft pulp, 850 mtpd from by product and whole log chips and 420 mtpd from sawdust and shavings, or
- mechanical pulp, 2 140 mtpd from by-product and whole log chips

c) East Kootenay Supply Area:

- Kraft pulp, 400 mtpd from by-product and whole log chips and 290 mtpd from sawdust and shavings, or
- mechanical pulp, 1 020 mtpd from by product and whole log chips

The location of a Kraft mill and/or a mechanical mill in the Kamloops Supply unit will depend on a number of environmental factors outside the scope of this report. On the basis of wood supply the pulp mill could be located in the north where it would depend primarily on the problem forest stands or in the south where it would depend on the surplus residue chips and incremental fibre. The viability of any new mill would depend on rationalizing the by-product fibre supply and on its ability to utilize the higher cost pulp log and incremental fibre supply volumes.

The major challenge, particularly for a Kraft mill, will be in locating a site which has an adequate water supply and is socially and environmentally acceptable.

Expansion of the Castlegar mill could be supported by harvesting pulp logs from the West Kootenay area. The mill would continue to purchase all by-product fibre from the Boundary and Arrow TSA's. Additional capacity is possible through the use of incremental fibre and sawdust and shavings.

This estimate of fibre supply indicates that an expansion of the pulp mill at Skookumchuck is possible if part of its supply can be obtained from the use of incremental fibre. Additional expansion is also possible through the harvesting of some fibre categories from portions of the West Kootenay Supply area.

This option assumes that fibre can be obtained at an average unit cost which can be supported by the market price of pulp and that no new technology is required to harvest and process the problem stands into suitable chips. It would utilize 90% or more of the estimated potential wood supply in each region. As an alternative to the expansions at Skookumchuck and Castlegar, a pulp mill could be located in the Golden - Revelstoke area.

After 40 years when the problem forest stands are liquidated, pulp fibre would have to be obtained from a much higher utilization of the forest resource.

This could be from:

1. Intensive Forestry.

Intensive forestry programs would provide a large but unknown source of supply. In addition the rehabilitation of the problem forest stands and other intensive forestry programs will provide an increase in the long run sustained yield. This has not been taken into account in the calculations of the short term supply.

2. Salvage of fire damaged, diseased or bug killed trees.

This source of fibre was not included in the estimated supply but could probably provide a large volume of fibre both in the short and long term.

These sources should provide adequate fibre to replace any shortfall after 40 years.

Under the option of full development the present movement of by-product chips to the coast would be restricted to that which would be surplus to the need of industry within the region. If the free flow of chips is to be maintained then the potential for a major new mill in the region is limited. The policy of chipping pulp logs and exporting chips from the area will also have to be examined should the demand increase due to new mills being constructed in the region.

APPENDIX I

Glossary of Technical Terms

Allowable Annual Cut (AAC)

The AAC is the annual rate of harvest set by the Ministry of Forests for a managed unit.

Average Volume Lines (AVL's)

These are inventory tables giving the average timber volume per hectare for mature stands by species, age, height and number of trees per hectare.

Bone Dry Unit (BDU)

A unit of measure for wood chips. A BDU contains 2 400 lbs of wood, oven dry.

Diameter Breast Height (dbh)

The diameter of trees taken 1.3 metres above ground level.

Decadent Stands

Stands with a high proportion of timber containing rot or other defect which limits its use for lumber.

Environmental Protection Forest (EPF)

An area containing commercial forest that is not available for harvest because of its higher value for other users or because present logging methods will cause unacceptable degradation of the site.

Incremental Fibre

This is fibre suitable for pulp manufacture obtained through improvements in present harvesting, milling and handling procedures.

Intensive Forestry

Any silvicultural practice beyond a defined basic level which improves forest growth.

Long Run Sustained Yield (LRSY)

LRSY for any Timber Supply Area is equal to the culmination of mean annual growth on all productive forest land.

mtpd

This is an abbreviation for metric tons per day.

Pulplogs

These are defined as any logs which cannot be used for sawlogs and contain soundwood suitable for pulp manufacture.

Pulping Processes

Kraft - a chemical process which uses sodium sulphate to digest the lignin out of the wood.

Thermo-mechanical pulp (TMP) - a mechanical process where the chips are steamed before mechanical separation of the fibres.

Chemi-mechanical (CMP) - a variation of the TMP process where the wood is subjected to a mild chemical pretreatment before mechanical separation of the fibres.

Roundwood Fibre

Pulp fibre obtained from processing logs directly into chips.

Sawlogs

Logs which are suitable for processing into lumber or other solid wood products.

Sawmill Residues

Chips, sawdust and shavings produced as by-products of lumber manufacture.

Stagnant Stands

Stands which because of the great number of trees per hectare are no longer adding significant growth.

Stock and Stand Tables

Tables developed from cruise data used to predict mortality and growth of stands over a period of time.

Timber Supply Area (TSA)

A specified area of the province created by the Ministry of Forests for the purpose of analyzing, planning, and managing timber resources. Boundaries have been established considering present and expected population centers, transportation networks, and manufacturing facilities.

Timber RAM

Timber Resource Allocation Method, a linear programming long term whole forest computer model.

Unavoidable Waste

Soundwood which is unuseable for lumber because of the proximity of decay or other defect.

Volume over Age Curves (VAC)

Curves developed from inventory data showing timber volume in relation to age in terms of site quality and species characteristics.

Yield Analysis

The study of potential forest yield in future time periods.

APPENDIX II

Discussion of Pulping Processes

There are two basic methods used in B.C. to transform wood fibre into pulp: chemical and mechanical. Each process yields a pulp with characteristics that are most suitable for different products. The chemical processes dissolve and remove the lignin from the wood leaving a relatively pure cellulose fibre. In mechanical pulping the fibres are torn apart, often with considerable breakage and with little or no lignin extraction. Pulp characteristics and yield are directly related to the amount of lignin extracted from the wood (Table i)

Table i Variation in Yield and Relative Strength According to Pulping Process

<u>Pulp Class</u>	<u>Process</u>	<u>Yield %</u>	<u>*Relative Strength</u>
Chemical	Sulphate (kraft)	40-45	9-10
	Sulphite	45-55	7
Mechanical	Stone groundwood	90-96	4
	Refiner groundwood	90-96	4
	Thermo-mechanical	90-96	6
	Chemi-mechanical	85-92	7

*Very general rating of relative strengths with a rating of 10 assigned as maximum for high quality kraft.

Chemical

Two chemical processes are currently used in B.C. to delignify wood: acid sulphite and alkaline sulphate or kraft. The Western Forest Products mill at Port Alice is the only remaining sulphite mill in the province, all

the other chemical mills use the kraft process. The main reasons for the use of kraft over mechanical or other chemical process are:

- a) a very desirable, stable product with a high market demand is produced,
- b) almost any wood species can be used to produce a high strength pulp,
- c) process chemicals can be recovered and re-used, and
- d) there is a concurrent recovery of by-product heat.

The main disadvantages of kraft are, on the other hand, serious enough to limit the development of new mills. These include:

- a) high capital cost per unit of production because of the complex recovery boiler system, pollution control requirements and a very large minimum efficient size, in the order of 750 metric tonnes per day. Present day capital costs per mill are in the order of 450 million dollars.
- b) lower yield than other processes which combined with the high minimum size requires a wood supply of about 500 000 BDUs (1.4 million m³) of chips per year.
- c) air pollution, resulting from trace amounts of hydrogen sulphide, methyl mercaptan, dimethyl sulphide, dimethyl disulphide plus steam carried volatile organic compounds.

Recent advances in technology will reduce air and water pollution and may make kraft mills more acceptable environmentally, but at an even higher cost per unit of production and with a reduced net energy recovery. Very few new greenfield kraft pulp mills have been built in the world in the last ten years.

Mechanical

Most of the mechanical pulp mills in the Province are in integrated mills producing newsprint or other papers.

1. Stone groundwood

Stone groundwood is the oldest of the current pulping techniques, originating in the mid 1800's. It is commonly used for non permanent types of paper such as newsprint, industrial papers, towelling, tissue and paperboard. Newsprint usually contains up to 15% chemical pulp to increase strength. Pressurized stone groundwood mills are still being built to produce a pulp suitable for newsprint.

The advantages of pressurized stone groundwood are its high yield and low capital costs per unit of production. Disadvantages are the low strength of the pulp, low non-permanent brightness, whitewood species requirements, and the need for solid, sound wood blocks.

2. Refiner groundwood (RMP)

The refiner groundwood process was developed in the 1950's to process wood in the form of chips or sawdust. When the chips are passed between two closely spaced counter-rotating steel plates the fibres are torn apart. Pulp properties are varied by controlling the distance between the refiner plates and by placing refiners in series.

Mechanical pulp from disc refiners has several advantages over stone groundwood. Low quality logs and sawmill residues can be reduced to chips and used to produce high quality pulp. Refiner pulp has a much higher long fibre fraction than groundwood and results in paper with 100% higher tear and 40% higher tensile strength.

Softwoods, such as spruce, hemlock and fir produce higher quality and stronger pulps than do hardwoods. Of these spruce is the preferred species because it requires less bleaching to achieve the desired brightness. Hardwoods can be used but are better used with a chemical pretreatment before refining.

3. Thermo-mechanical (TMP)

The main difference between RMP and TMP is that the chips, rather than being refined under atmospheric conditions, are pre-steamed under a controlled pressure and refined either at the same pressure or a different one.

Thermo-mechanical pulping offers several advantages over atmospheric refiner mechanical pulping. Depending on wood species, TMP has strength qualities from 20% to 100% higher than RMP. Because of this the TMP process can accept chips from species which would not be acceptable for the RMP process.

One of the main disadvantages of TMP is the high external energy requirements. In the mechanical pulping process about 98% of the energy applied to the wood is converted to heat in the form of steam. However, if an efficient heat recovery system is installed the specific energy required to produce thermo-mechanical pulp approaches those for stone groundwood but results in much higher pulp strengths.

The major advantages of TMP over the kraft process are: higher yield, smaller minimim plant size and fewer pollution problems.

4. Chemi-Thermo-Mechanical (CIMP or CMP)

Chemical treatments range from impregnating chips with small amounts of sodium sulphite (1-5%) prior to refining under heat and pressure (CIMP) to cooking the chips in a digester with around 10% sodium sulphite prior to either atmospheric refining or pressurized refining. At the higher chemical pretreatment levels and under more severe conditions of digestion, high yield chemi-mechanical pulps (CMP) can be produced which are suitable for partial or complete replacement of the chemical pulp component of newsprint or other lower grade papers.

The pretreatment of chips with chemicals followed by either atmospheric or pressurized refining extends the range of uses of pulps from both softwoods and hardwoods. The improved quality along with the higher yield, lower capital costs and reduced pollution compared to chemical pulps enables CMP to be used as a replacement for kraft pulp in many applications.

The major drawback to CIMP at the present time is that of market acceptance. Market CIMP mills must produce a high quality pulp which means that only certain species of wood can be used. Presently spruce and aspen are the preferred species with pine slightly less acceptable.